General public description of the project entitled *"Transient gravitational waves from neutron stars: models and data analysis"*

Until recently the vast majority of knowledge was acquired by astronomers using one of the four fundamental interactions: the electromagnetism mediated by various energy photons (radio, visible light, X rays etc.) In comparison, gravity is perhaps the most prosaic of fundamental interactions in our everyday life, but it is also the most mysterious.

Recent direct observations of gravitational waves, the echoes of distant mergers of black-hole binaries, GW150914 and GW151226, detected and analyzed by the LIGO-Virgo collaboration opened a possibility of studying the Universe from a completely different perspective.

Gravitational-wave astronomy lets us directly probe extreme regimes of strong gravity - vicinity of black-hole horizons and of neutron stars - during violent astrophysical phenomena in which the spacetime curvature is dynamically changing. Gravitational waves are created by fast, large-scale movement of massive bodies, and after the emission they interact very weakly with the surroundings, providing a view otherwise obscured for traditional (electromagnetic) observations. They are important in studying the densest, most extreme matter in the Universe - the largely unknown interiors of relativistic compact neutron stars.

This proposal aims at studying the transient neutron-stars gravitational-wave phenomena. We will establish novel data analysis methods based on modern machine learning (neural networks) techniques for robust detection. We will also study numerical models of neutron stars, describing the gravitational waves caused by the instabilities due to accretion, equation of state and other processes occurring in their interiors. These predictions will be used as templates in gravitational-wave searches and confronted with astrophysical observations.